

WIND

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Among the most difficult, but one of the most important parts of weather forecasting is the wind. The wind has an impact on a large variety of outdoor activities and transportation, as well as on people and building structures. In northeast Montana, we see the wind coming into play every day in a wide variety of activities, including boating, fires, construction, crop and insect spraying, fishing and hunting, and blowing and drifting of snow. At its worst, the wind can destroy most anything, as we see in tornadoes.

Large-scale, high and low pressures systems and their intensity and proximity to each other, are the main causes of wind, such as the highs and lows we see on weather maps. These maps are drawn from observation sites though that are typically 50 to 100 miles apart. Therefore, important smaller-scale pressure details are often lacking. As we shall see, these small-scale influences can be very important.

Winds blow from high pressure to low pressure. Because of the Coriolis force, caused by the rotation of Earth on its axis, the wind does not blow directly from high pressure to low pressure. Instead, it tends to blow at a 90 degree angle to the pressure gradient. This angle is less near the surface of the Earth though, due to friction.

To complicate wind forecasts, winds aloft often mix down to the surface. The heights of these mixing winds are often 5 to 10 thousand feet off the ground. That particular height is determined by several meteorological characteristics of the air mass, as well as the time of day.

When the large-scale pressure gradients are weak, winds often take on local characteristics. These are determined mainly by geographical features and differences in land-use or vegetation. These cause uneven temperatures that lead to small-scale pressure differences. Mountains, hills, coulees, valleys, and lakes all develop their own local winds systems. Other meteorological conditions such as differences in cloud cover and type, and snow cover can have a large impact on winds due to uneven heat. Mountains, hills and forests can block or deflect winds, while valleys, canyons and coulees can steer wind direction, as well as enhance speeds. Acting like geographical features, buildings and pavement can have the same effect on wind in cities. The combination of multiple influences can make for a very complex wind pattern in the small-scale.

Thunderstorms are a wind system of their own. Thunderstorms imply the potential for sudden and gusty winds, along with changeable wind direction. They can completely overwhelm any other small or large-scale winds that are occurring, often with little notice. If thunderstorms produce a wind over 58 mph,

they are considered severe thunderstorms. Every spring and summer, many such severe thunderstorms strike northeast Montana, causing varying amounts of damage. With multiple strong or severe thunderstorms, the pressure pattern can become very complex, and very difficult, to nearly impossible to forecast for more than an hour in advance.